

CLAIMS

1. An apparatus for irradiating a sample, comprising:
 - a) an interferometer forwarding an electromagnetic radiation; and
 - b) a sample arm receiving the electromagnetic radiation, the sample arm
5 including an arrangement which facilitates a production of at least two radiations from the electromagnetic radiation so as to irradiate the sample, the arrangement being configured to delay a first radiation of the at least two radiations with respect to a second radiation of the at least two radiations.
2. The apparatus according to claim 1, further comprising:
 - 10 c) a reference arm providing a further electromagnetic radiation, wherein the interferometer receives the first, second and further radiations, and forms a resultant signal based on the first, second and further radiations; and
 - d) a processing arrangement generating a first image based on the first radiation and a second image based on the second radiation, wherein the first
15 and second images are different from one another.
3. The apparatus of claim 2, wherein the processing arrangement generates a further image based on the first and second images.
4. The apparatus of claim 3, wherein the further image has a noise that is smaller than a noise of the first image and a noise of the second image.
- 20 5. The apparatus according to claim 4, wherein the further image has a signal to noise ratio that is improved according to the equation:

$$SNR_{ACPE} = \frac{\langle S_{OCT} \rangle}{\sqrt{\text{var}[S_{OCT}]}} \propto \frac{\sum_{i=1}^N u_i}{\sqrt{\sum_{i=1}^N u_i^2}},$$

wherein SNR_{ACPE} is the signal to noise ratio, S_{OCT} is an amplitude of a high-pass filtered OCT signal, m is a thickness of the arrangement, u_i is an amplitude of a demodulated OCT signal at a spatial location, and $N = 2m - 1$.

6. The apparatus according to claim 5, wherein $m=2$ and $N=3$ images associated with the at least two radiations are obtained.
7. The apparatus according claim 3, wherein the further image is generated based on a mathematical combination of the first and second images.
8. The apparatus according to claim 2, wherein the sample is irradiated by the first irradiation at a first angle, wherein the sample is irradiated by the second radiation at a second angle, the first and second angles different from one another.
9. The apparatus according to claim 8, wherein the first and second angle are different from one another based on the delay and at least one of a phase and a incident angle of each of the first and second radiations.
10. The apparatus according to claim 2, further comprising a detector which detects the first electromagnetic energy, and forwards the detected energy to the processing arrangement.
11. The apparatus according to claim 1, wherein the arrangement includes two sections, each being configured to delay a respective one of the first and second radiations, and wherein a delay of the first radiation is greater than a delay of the second radiation.
12. The apparatus according to claim 1, wherein the delay of a path of the first radiation compared to a path of the second radiation is at least $500\mu\text{m}$ in air.

13. The apparatus according to claim 1, wherein the delay of a path of the first radiation compared to a path of the second radiation is at least 1mm in air.
14. The apparatus according to claim 1, wherein the arrangement has a refractive index of at least 1.5.
- 5 15. The apparatus according to claim 1, wherein the arrangement has a refractive index of at least 3.0.
16. The apparatus according to claim 1, wherein the arrangement includes silicon.
17. The apparatus according to claim 1, wherein the arrangement includes an anti-reflective coating on at least one surface thereof.
- 10 18. The apparatus according to claim 1, wherein the arrangement comprises an anti-reflection-coated BK 7 glass.
19. The apparatus according to claim 16, wherein the glass has a thickness of from about 1.6 mm to about 7.7 mm.
20. The apparatus according to claim 16, wherein the glass has a refractive index
15 of from about 1.51 to about 3.5.
21. A catheter comprising:
- a) an interferometer forwarding an electromagnetic radiation; and
- b) a sample arm receiving the electromagnetic radiation, the sample arm including an arrangement which facilitates a production of at least two
20 radiations from the electromagnetic radiation so as to irradiate the sample, the arrangement being configured to delay a first radiation of the at least two radiations with respect to a second radiation of the at least two radiations.
22. A probe for optical coherence tomography imaging, comprising:
- a. an interferometer forwarding an electromagnetic radiation; and
- 25 b. a sample arm receiving the electromagnetic radiation, the sample arm including an arrangement which facilitates a production of at least two

radiations from the electromagnetic radiation so as to irradiate a sample, the arrangement being configured to delay a first radiation of the at least two radiations with respect to a second radiation of the at least two radiations.

23. A method for irradiating a sample, comprising the steps of:

- 5 a. providing an electromagnetic radiation from an interferometer; and
- b. in a sample arm, facilitating production of at least two radiations from the electromagnetic radiation so as to irradiate the sample, a first radiation of the at least two radiations being delayed with respect to a second radiation of the at least two radiations.

10 24. An apparatus for imaging, comprising:

- a. a sample arm receiving an electromagnetic radiation, the sample arm including an arrangement which facilitates a production of at least two radiations from the electromagnetic radiation so as to irradiate a sample, the arrangement being configured to delay a first radiation of the at least two radiations with respect to a second radiation of the at least two radiations;
- 15 b. a device receiving the first and second radiations from the sample arm and at least one third radiation from a reference arm, wherein the first and second radiations interfere with the third radiation;
- c. at least one of spectral separating unit which separates spectrum of at least one of the first, second and third radiations into frequency components;
- 20 and
- d. at least one detection arrangement including a plurality of detectors, each detector capable of detecting at least a portion of at least one of the frequency components.

25 25. An apparatus comprising:

- a. at least one first arrangement providing at least one first electromagnetic radiation to a sample arm and at least one second electro-magnetic radiation to a non-reflective reference arm, wherein a frequency of radiation

provided by the first arrangement varies over time, wherein the sample arm receives the first electromagnetic radiation, the sample arm including an arrangement which facilitates a production of at least two radiations from the electromagnetic radiation so as to irradiate a sample, the arrangement being
5 configured to delay a first radiation of the at least two radiations with respect to a second radiation of the at least two radiations; and

b. at least one second arrangement detecting an interference between the first and second radiations generated at the sample arm and the second electromagnetic radiations generated at the reference.

10 26. An apparatus comprising:

a. at least one first arrangement providing at least one first electromagnetic radiation to a sample arm and at least one second electro-magnetic radiation to a reference arm, wherein at least one of the first and second electro-magnetic radiation has a spectrum which changes over time, the
15 spectrum containing multiple frequencies at a particular time, wherein the sample arm receives the first electromagnetic radiation, the sample arm including an arrangement which facilitates a production of at least two radiations from the electromagnetic radiation so as to irradiate a sample, the arrangement being configured to delay a first radiation of the at least two
20 radiations with respect to a second radiation of the at least two radiations; and

b. at least one second arrangement detecting an interference between the first and second radiations generated at the sample arm and the second electromagnetic radiations generated at the reference.